

**REMARKS**

Applicants respectfully request reconsideration and allowance of the pending claims.

**I. Status of the Claims**

Upon entry of this amendment, claims 1, 5-9, and 74-94 remain pending. Claims 2, 74-80, and 87-90 have been canceled.

Claim 1 has been amended, which is supported by applicants' published application at paragraphs [0049] and [0052].

Claim 81 has been amended to make it independent. The amendments are supported by applicants' published application at paragraphs [0045], [0051], and [0052]. Claims 91-94 have been amended to make them depend from claim 81.

**II. Claim Rejections Under 35 U.S.C. 103(a)**

Reconsideration is requested of the rejection of claims 1-2, 5-9, and 74-94 as being obvious over Itoh et al. (U.S. 5,024,905) in view of Ovshinsky et al. (U.S. 2003/0050188).

Claim 1 is directed to a composition for use as a catalyst in oxidation or reduction reactions, the composition comprising electrocatalyst alloy particles comprising an alloy of platinum and copper, wherein

- (i) the concentration of platinum in the electrocatalyst alloy particles is greater than 50 atomic percent and less than about 80 atomic percent,
- (ii) the electrocatalyst alloy particles have an average particle size which is less than 25 angstroms (Å),
- (iii) the sum of the concentrations of platinum and copper in the electrocatalyst alloy particles is greater than 98 atomic percent, and

(iv) a particle size distribution of the electrocatalyst alloy particles is such that at least 80 percent of the particles are within about 75 to about 125 percent of the average particle size.

The composition defined by claim 1 is therefore directed to electrocatalyst particles comprising Pt and Cu in a minimum concentration such that components other than Pt and Cu are present, if at all, at a concentration of no more than 2 atomic percent. The particles have an average particle size of less than 25 angstroms and a specified distribution range wherein at least 80% of the particles are within 75 and 125% of the average particle size. For example, if the average particle size is 20 angstroms, 80% of the particles are within 15 and 25 angstroms.

The cited Itoh et al. reference does not disclose any composition comprising Pt-Cu electrocatalyst alloy particles in which the Pt concentration is at least 50 atomic %, the average particle size is less than 25 Å, and the sum of the concentrations of Pt and Cu is at least 98 atomic %. Nor does the reference disclose any particle size distribution data whatsoever, much less the tight distribution required by applicants' claims. Nor does the reference even enable the ordinarily skilled person to prepare such a population of Pt-Cu alloy particles.

The cited Ovshinsky et al. publication does not enable the preparation of predominantly Pt, or any noble metal, particle materials having the claimed average particle size limitation, and in fact teaches away from such particle size limitations by explicitly stating that Angstrom-sized noble metal particles are "extremely difficult to produce..." See paragraph [0035]. In view thereof, as explained in further detail below, the cited

combination of references does not render the composition defined by claim 1 obvious.

Itoh et al.'s platinum alloy electrocatalyst comprises platinum in a concentration range from 40 to 70 atomic %, iron in a concentration range from 9 to 27 atomic %, cobalt in a concentration range from 9 to 27 atomic %, and copper in a concentration range from 9 to 27 atomic %. The maximum sum of platinum and copper is therefore 70 atomic % + 27 atomic % = 97 atomic %, which is less than the claimed minimum of 98 atomic %. Itoh et al. further teach away from modifying their alloy by increasing either the Pt or the Cu concentrations in order to yield an alloy having at least 98 atomic % Pt and Cu. See Col. 4, line 57 to Col. 15, line 13:

With regard to the proportions of the metals deposited on the quaternary alloy catalyst of this invention, if the proportion of at least one of the iron, cobalt and copper elements is less than 9 atomic %, **or the proportion of platinum exceeds 70 atomic %**, the effect of adding iron, cobalt and copper on the activity of the catalyst does not appear markedly, and the resulting catalyst only shows activity equivalent to that of a catalyst comprising platinum alone, that of platinum-iron, platinum-cobalt and platinum-copper binary alloy catalyst, or that of a platinum-iron-cobalt or platinum-iron-copper ternary alloy catalyst.

Even if the proportions of all of iron, cobalt and copper are at least 9 atomic %, **but if the proportion of at least one of them exceeds 27 atomic %**, and the proportion of platinum is at most 55 atomic %, or if the proportion of platinum is less than 40 atomic %, unnegligible proportions of iron, cobalt and/or copper dissolve in the acid electrolyte and disintegration of the alloy phase occurs to reduce the stability of the catalyst.

The composition range which brings about an increase both in catalytic activity and in catalyst stability is 40 to 70 atomic % for platinum, 9 to 27 atomic %

for iron, 9 to 27 atomic % for cobalt and 9 to 27 atomic % for copper.

The maximum concentration limits of each component are not preceded by "about" or similar such terms that convey flexibility in concentrations. Itoh et al. therefore have strictly delineated the maximum concentrations of the components of their alloys to the disclosed ranges. There is therefore no overlap; and no *prima facie* obviousness.

The cited portion of Itoh et al. for particle size, at Col. 9, lines 50-56, pertains to a Pt:Fe:Co:Cu in an atomic ratio of 50:17:17:17. This alloy has a Pt + Cu concentration of 67 atomic %, which is substantially less than the claimed minimum of >98%. Moreover, this material, which is Production Example 2, is stated to have a "Crystallite size" (i.e., average particle size) in Table 1 of 33 angstroms, which is substantially higher than the maximum average particle size required by claim 1.

The only alloys in Itoh et al. that comprise Pt and Cu in concentrations that may sum to as much as 98 atomic percent are those of Production Example 13, but these alloys have "crystallite sizes" (i.e., average particle sizes) of 35 angstroms and 37 angstroms. See Table 2. The composition defined by claim 1 is patentable over these alloys since that composition requires electrocatalyst alloy particles having an average particle size which is less than 25 angstroms (Å), with a tight distribution pattern of 80% between 75 and 125% of the average.

As admitted by the Office, "Itoh does not explicitly teach the electrocatalyst alloy particles have an average particle size which is less than 25 angstroms." In view of this and other clearly apparent shortcomings of Itoh et al., the Office

cites Ovshinsky et al., which is asserted to disclose that it would have been obvious to prepare Pt-Cu catalyst particles having the claimed alloy particle size to "eliminate the 'bulk' waste of expensive metals such as platinum and maximize the surface area of the electrocatalyst..." This cited portion of Ovshinsky et al. merely expresses the disadvantage of using Pt and other noble metals as catalysts -- the bulk atoms of an expensive material cannot be utilized in catalytic reactions. But, neither this cited portion nor any of the rest of Ovshinsky et al.'s specification discloses or enables the preparation of Pt-based alloy (or any noble metal) particles having the claimed particle size limitation.

The Ovshinsky et al. disclosure relied upon by the Office is extracted from and cited out of context from paragraph [0035] of their publication:

[0035] One aspect of the instant invention is the practical embodiment and method of producing "ultra fine catalysts". Since the catalytic properties of a material are primarily a surface property (rather than a bulk property), large catalytic metal particles essentially waste the interior metallic atoms. For expensive elements, such as platinum, palladium, gold, silver, etc., the waste of material is unacceptable. Therefore, the smaller the metallic particles, the better, since the surface area for catalysis rises proportionally. However, ***it is extremely difficult to produce Angstrom size metallic particles.*** Hence, by providing very small particles, such as 10-50 Angstrom size particles (which themselves may have additional surface area due to surface roughness) in a finely divided distribution, improvements in reaction rate can be produced.

Paragraph [0035] sets forth a problem: it is inefficient to use expensive metals such as Pt or other noble metals in a catalyst since interior bulk atoms are wasted. Ovshinsky et al. additionally recognized that it is extremely difficult to

overcome this inefficiency since "it is extremely difficult to produce Angstrom size metallic particles." However, contrary to the suggestion in the Office action, Ovshinsky et al.'s solution to the problem of wasteful bulk Pt atoms is not to provide a method of preparing smaller Pt-based alloy particles. Rather, they recommend avoiding the use of Pt or other noble metals altogether. I.e., they use **non-noble** metals to make electrocatalyst particles. See paragraph [0027]:

[0027] In a preferred embodiment of the present invention, the **metal particles are non-noble metal**. Alternatively, **noble metals may be provided in the support, but separate from the particles**. In another alternative embodiment, non-noble metals may be combined in the particles with noble metals, preferably as an alloy, composite, or solid solution.

So Ovshinsky et al.'s solution to the problem of wasteful bulk Pt atoms is to prepare metal particles of non-noble metal. They further explicitly state that although noble metals may be used in formulating metal oxide supports, the noble metals are "separate from the [non-noble metal] particles." Ovshinsky et al.'s inventive contribution is the provision of a method of making very small non-noble metal catalyst particles embedded in a metal oxide (which may be a noble metal oxide) support. By making the non-noble metal catalyst particles small, any deficiencies in activity of the non-noble metals compared to noble metals may be compensated for by increase in surface area. See paragraph [0095]:

[0095] The electrodes were tested in side-by-side comparisons in half-cell test with a mercury/mercury oxide reference electrode and an oxygen reduction counter electrode, the results of the tests are graphically illustrated FIG. 2. As shown in FIG. 2, an

electrode made with a catalyst in accordance with the present invention provides substantial improvement over other electrodes and over that of the commercial, control electrode. As can be seen by the comparison, catalyst in accordance with a preferred embodiment of the present invention can be made with higher current density. However, *it is still within the spirit and scope of the invention that even if the catalysts as described above were worse than platinum and/or palladium catalysts, they may still have commercial applicability under a cost benefit analysis. This is not only because these non-noble catalysts are so much less expensive on a relative basis than either platinum or palladium, but also because the size and the surface area can be formed much smaller and higher respectively.* The overall consequence is that the catalyst user has a higher available concentration of catalyst per unit area compared to conventional platinum or palladium. Further, long-term benefits, other than cost, may include the ability of these "ultra fine catalysts" to operate with relatively long lives in unusually hostile environments without degradation. There is also the advantage the these catalyst can be made very conductive with certain base alloys. As such, a catalyst of a preferred embodiment preferably has a current density of greater than 0.08 amps/cm<sup>2</sup> at a voltage of -0.75 V or less at room temperature.

Ovshinsky et al. state, clearly, that it is possible to form **non-noble** metal catalysts much smaller than is possible for platinum and/or palladium catalysts. **The technical obstacles to making small Pt particles loomed so large that Ovshinsky et al. opted instead to work with the less potent non-noble metals.**

Thus, the ordinarily skilled person would have read paragraphs [0035] and [0095] and the rest of Ovshinsky et al. as showing the opposite of what the Office has cited Ovshinsky et al. to show. That is, the ordinarily skilled person had, at the time of applicants' invention, recognized that interior Pt atoms in a Pt-based catalyst material were wasted since they are unavailable for reaction. The desired solution would be the

preparation of smaller Pt-based catalyst particles to minimize the number of interior or bulk Pt atoms in the alloy particles. If Ovshinsky et al. could have solved this problem without resort to non-noble metals, they would have since Pt is a superior catalyst metal than non-noble metals. The fact that they did not disclose any such solution means that not only that Ovshinsky et al. failed to "enable," but that they could not have "enabled" even though they had wanted to! See MPEP §2143.02 Reasonable Expectation of Success Is **Required**. It is not enough that a prior art reference recites the limitations of a pending claim; the disclosure must be an enabling one. Ovshinsky et al. failed to enable the preparation of Pt or other noble metal alloy particles having an average particle size of less than 25 Å. The Federal Circuit has stated that "even if the claimed invention is disclosed in a printed publication, that disclosure **will not suffice as prior art** if it was not enabling." *In re Donohue*, 766 F.2d 531, 533 (Fed. Cir. 1985), citing *In re Borst*, 345 F.2d 851, 855, 145 USPQ 554, 557 (CCPA 1965). The Ovshinsky et al. reference, like Itoh et al., is not enabling -- thus the combination does not suffice as prior art, per *Donohue*.

Rather than showing that it is obvious to prepare Pt-Cu (or any noble metal) alloys in small particle sizes, Ovshinsky et al. establish that as of the time of Ovshinsky et al.'s filing in July 2002 (which is only about 1 year prior to applicants' filing date of August 2003), in the art of Pt-based (and other noble metals) alloy electrocatalysts, the ordinarily skilled person recognized the difficulty in preparing small Pt-based alloy particles, had not enabled the preparation of very small Pt-alloy particles, and had been forced to seek solutions elsewhere, i.e., non-noble metals, since they were easier to form into smaller particles. Applicants' composition defined by

claim 1 is therefore a significant, non-obvious improvement in the Pt-based alloy electrocatalyst art. Simply stated, applicants succeeded in making smaller particles out of a noble metal, Pt, where others, in particular, Itoh et al. and Ovshinsky et al., notably failed.

There is thus no disclosure in either Itoh et al. or Ovshinsky et al. of Pt-Cu alloy electrocatalyst particles meeting the claimed average particle size; nor is there any enablement of such Pt-Cu alloy electrocatalyst particles in the art of record. In view thereof, applicants respectfully submit that the composition defined by claim 1 is patentable over the cited references.

Claims 2, 74-80, and 87-90 have been canceled.

Claims 5-9 and 82-86 depend from claim 1 and are patentable for the same reasons as claim 1 and by virtue of the additional requirements therein.

Claim 81 is directed to a composition for use as a catalyst in oxidation or reduction reactions, the composition **consisting of** electrocatalyst alloy particles **consisting of** an alloy of platinum and copper, wherein

- (i) the concentration of platinum in the electrocatalyst alloy particles is greater than 60 atomic percent and less than about 80 atomic percent, and
- (ii) the electrocatalyst alloy particles have an average particle size which is less than 20 angstroms (Å), and
- (iii) the sum of the concentrations of platinum and copper in the electrocatalyst alloy particles is greater than 99 atomic percent, and
- (iv) wherein a particle size distribution of the electrocatalyst alloy particles is such that at least

90 percent of the particles are within about 75 to about 125 percent of the average particle size.

The composition of claim 81 is patentable over Itoh et al. in combination with Ovshinsky et al. since Itoh et al. limit the combination of Pt and Cu in their composition to only 97 atomic %. Moreover, the composition defined by claim 81 consists of electrocatalyst alloy particles consisting of an alloy of platinum and copper, which is further distinguishable over Itoh et al. since they disclose a quaternary alloy additionally comprising cobalt and iron, which are excluded from the composition by virtue of the "consisting of" transitional phrase. The composition of claim 81 is further patentable since the average particle size is less than 20 angstroms, which is neither disclosed nor even enabled by Itoh et al. and Ovshinsky et al. for the reasons stated above in connection with claim 1. Briefly, all of Itoh et al.'s production examples had average particle sizes higher than 30 angstroms, and Ovshinsky et al. utterly failed to produce Pt or other noble metal particles having smaller particle diameters, so they instead turned to non-noble metals which are more easily formed into smaller particles.

Claims 91-94 depend from claim 81 and are patentable for the same reasons as claim 1 and by virtue of the additional requirements therein.

### **III. Double Patenting Rejections**

Applicants acknowledge the provisional double patenting rejection of claims 1, 5-8 and 74-75 over claims 1, 5, and 14 of co-pending application Ser. No. 11/205,557 in view of Ovshinsky et al., U.S. 2003/0050188. Claim 1 now requires a minimum sum of the platinum and copper concentrations that is more stringent

than what was required by now canceled claim 2. Since claim 2 was not rejected as double patenting the claims of co-pending application Ser. No. 11/205,557, applicants respectfully submit that claim 1 and its dependent claims are patentably distinct from the claims of co-pending application Ser. No. 11/205,557. In view thereof, applicants respectfully request the double patenting rejection be withdrawn.

Moreover, unless and until the co-pending application matures into patents or the double patenting rejection is the sole remaining rejection in the present case, the appropriateness of the rejection cannot be ascertained. Applicants therefore request that the double patenting rejection be held in abeyance until one of these conditions is met.

**CONCLUSION**

Applicants do not believe that a fee is required for the filing of this response, as it is being submitted within the three month shortened statutory period for reply. Should applicants be incorrect, the Commissioner is hereby authorized to charge the necessary fee to Deposit Account No. 19-1345.

Respectfully submitted,

/paul fleischut/

Paul Fleischut, Reg. No. 35,513  
SENNIGER POWERS LLP  
100 North Broadway, 17th Floor  
St. Louis, Missouri 63102  
(314) 231-5400

PIF/NAK/mrt